Inking system for intaglio printing machine

The present invention concerns an inking system for an intaglio printing machine printing securities, such as banknotes, checks, passports, ID and other similar objects.

In the field of multicolour intaglio printing it is necessary to fill both the fine and deep engraved lines of an intaglio plate with the accurate amount of ink in order to obtain a good print quality but, at the same time, minimising the excess of ink necessary to fill the fine engravings as well as the amount of ink transferred to the non-engraved area of the intaglio plate, thus improving the machine operability and reducing the ink consumption.

Examples of printing machines of the prior art are given by US patents 4,516,496, 5,062,359 and 5,899,145, the content of which is incorporated by reference in the present application.

The state of the art for intaglio printing machines and process provides an inking system with a rough regulation of the ink amount along the axis of the printing cylinder but with no means for regulation around the circumferential surface of the cylinder.

For example, means for more precise regulation are known from US patent 4,604,951 which discloses an intaglio machine having a conventional configuration characterised by a duct with ink holding recesses having different depths corresponding to those of the plate. This machine has never been commercialised; it has the following disadvantages:

-) The machine configuration uses only a direct inking process.
-) The described ink holding recesses on the duct cylinder cannot match precisely the engraved patterns on the intaglio plate.
-) The arrangement duct/blade described requires a continuous cylindrical surface, not compatible with plate clamping devices. Engraved plates are much easier to manufacture, install and serve than full cylinders.
-) High rigidity ink blade cannot be precisely controlled by adjusting screws.
-) The space between the ink blade and the duct roller will allow a high amount of ink on the non-engraved surface of the duct, then on the non-engraved surface of the intaglio plate, with no ink savings.
-) Reducing further the space between the ink blade and the duct will inevitably bring the blade in contact with the duct, damaging both the blade and the cylinder surface.

Other systems for improving the precision of deposition of the ink and for reducing the ink consumption have been developed in the prior art, for example, European patent application published under the number 1 442 878, the content of which is incorporated by reference in the present application. This patent application concerns an intaglio printing machine in which the selector cylinders used to deposit the ink on a collector cylinder are driven by drives in an independent manner allowing to vary the inking print length on the blankets of the collector cylinder.

Another example is disclosed in the European patent application published under the number 1 445 098, the

content of which is incorporated by reference in the present application. In this patent application, a blanket cylinder for an intaglio printing machine is made with different layers, each with different properties. Said layers are engraved and may be lipophilic and/or lipophobic thus achieving a very precise inking of the plate cylinder.

It is therefore an aim of the present invention to improve the known machines and processes.

It is a further aim of the present invention to provide a printing machine and a printing process that overcome the defects of the prior art.

It is another aim of the present invention to provide an intaglio printing machine and process that are easier to operate, give superior performance in print quality and ink savings.

To this effect, the invention complies with the definition of the claims.

The present invention will be best understood by the description of several embodiments and of the accompanying drawings in which

Figure 1 shows a first embodiment of the inking system according to the present invention.

Figure 2 shows a second embodiment of the inking system according to the present invention with a first configuration of printing machine.

Figure 2b shows a variant of the configuration of figure 2.

Figure 3 shows another configuration of a printing machine with the inking system according to the invention.

Figure 4 shows a further configuration of a printing machine with the inking system according to the invention.

Figure 5 shows a multicolor configuration of a printing machine with the inking system according to the invention.

In figure 1, a first embodiment of the inking system according to the invention is shown. In this embodiment, there is a duct, generally shown with the reference 1, said duct comprising a duct roller 2, an ink adjusting blade 3 for the duct roller 2 and an ink supply 4. The duct roller inks a selective inking cylinder 5 which has an engraved surface. The surface of the selective inking cylinder 5 can be directly engraved or, preferably, the cylinder carries an engraved plate with engravings corresponding to the pattern that has to be inked in the given color. In a manner known in the art, the inking cylinder comprises a pit 7 in which clamping means (not shown) are provided to hold the plate 6 in position.

The inking system further comprises a wiping roller 8, preferably a dry wiping roller, which is used to wipe the surface of the inking cylinder 5: thus only ink present in the engravings of the inking cylinder 5 remain and the ink present on the non-engraved surface of the cylinder 5 is almost completely removed.

The wiping system further comprises a scraping blade 9 for scraping the surface of the wiping roller and the ink thus scraped is recuperated in the ink supply 4 as shown in figure 1.

Accordingly, the ink supply function of the duct is separated from the ink thickness adjusting function. The duct roller 2 supplies an excess of ink to the selective inking cylinder 5 by means of the duct blade 3. The latter does not need to be equipped with adjusting screws, because there is no need of axial regulation of the amount of ink. The space between the duct blade 3 and the duct roller 2 does not need to be precisely adjusted. As an example, if the maximum required amount of ink requires a space of say 80 microns, the space can be adjusted with a wide excess tolerance, say 100-300 microns. This is because the duct roller 2 has no ink adjusting function. The duct roller 2 is preferably coated with hard rubber or plastic (for example PVC 50° ShD). It is removable from the press for maintenance or replacement and is equipped with state of the art means to adjust the contact with the selective inking cylinder 5 and is provided with liquid circulation for thermoregulation. Additionally, it is preferably equipped with a fast automatic on/off movement actuated at each revolution in order to avoid that the ink is transferred to the plate near the bending position.

The selective inking cylinder 5 has the function of ink adjusting and is equipped, as mentioned above, with a plate clamping device for an engraved plate 6, usually a chromed nickel plate. The engraved plate 6 is in rolling contact with the duct roller 2 and receives an excess of ink from it, the ink being transferred to both the engraved recesses

of the plate 6 and the plate surface. After the action of the dry wiping roller 8, each point of the engraved plate carries the exact amount (or a slight excess) of ink required for the intaglio printing process.

The dry wiping roller 8 is above the duct roller 2 and is in contact with the selective inking cylinder 5 and rotates in the same direction so that the two surfaces in contact run in opposite directions. Similarly to a conventional wiping unit wiping the intaglio plate, the dry wiping roller 8 removes the excess of ink from the plate 6 surface, leaving ink in the engravings. The excess of ink is transferred to the surface of the dry wiping roller 8 and a scraping blade 9 removes the largest part of the ink from the wiping roller 8 surface. The removed ink falls by gravity into the duct 1 and can thus be recycled.

Both, dry wiping roller 8 and scraping blade 9, are equipped with non synchronized axial movement, in order to even the wear of the roller surface. This is preferably coated with hard rubber or plastic (for example PVC at 50° ShD) and provided with thermoregulation (known in the art). The dry wiping roller 8 is preferably driven by an independent motor, to optimise the rotating speed in order to minimise the amount of ink left on the non engraved area of the selective inking plate 6. This is in the range of a few microns thickness. The scraping blade 9 is preferably in steel coated with ceramic. The surface of the dry wiping roller can be alternatively coated with a layer of ink repellent material in order to increase the amount of recycled ink which falls into the duct by the combined forces of gravity and centrifugation.

In figure 2, a second embodiment of an inking system is represented. In this embodiment, the duct 10 comprises an ink chamber 11 with an ink spraying device 12 that sprays on a duct roller 13. In this embodiment, due to the direction of rotation of the duct roller, it is not necessary to use a duct blade as in the first embodiment, therefore it is possible to directly use an engraved duct roller 13 (either with an engraved surface or carrying an engraved plate), thus simplifying the constructions. The ink spraying is synchronized with the duct roller rotation in order to avoid ink application in the non-engraved area of the duct roller and in the roller pit in presence of a plate clamping arrangement. Over the ink chamber 11, there is a wiping system with a wiping roller 8 and a scraping blade 9. Under the scraping blade 9, recuperating means are provided such as a tank 14 with pump means 15 to bring the recuperated ink into the circuit of ink being sprayed.

In the embodiment of figure 2, the printing machine represented is an indirect inking intaglio printing machine. Accordingly, the engraved duct, with engravings corresponding to the engravings of a plate cylinder 16, transfers the ink of the engravings onto a chablon roller 17 with reliefs 18 corresponding to the parts to be inked, said reliefs 18 transferring the ink to a collector cylinder 19 before being transferred to the plates of the plate cylinder 16. The same collector cylinder 19 can receive the inks of different colors from other inking units and chablon rollers not shown in figure 2 but similar to the inking unit represented. The process of indirect inking in an intaglio printing process is known per se in the prior art, for example from US patents 4,516,496, 5,062,359 and 5,899,145 mentioned above.

In figure 2b, a variant of the configuration of figure 2 is shown. In this variant, identical elements are identified with the same reference numbers. This variant differs from the configuration of figure 2 in the fact that the collector cylinder 19 of figure 2 is removed, thus forming a direct inking configuration. Accordingly, this variant comprises a duct 10, with an ink chamber 11 and a ink spraying device 12 on the duct roller 13. Under the spraying system, there is a wiping system with wiping roller 8, and scraping blade 9 and recuperating means, for example a tank 14 with pump means 15, for the scraped ink.

The engraved duct roller 13, with engravings corresponding to the engravings of the plate cylinder 16, transfers the ink of the engravings onto the chablon roller 17 with reliefs 18 corresponding to the parts to be inked, said reliefs 18 transferring the ink to the plates of the plate cylinder 16.

In figure 3, a configuration of a printing machine with the inking system according to the invention is shown. In this configuration, the machine has a direct inking of an intaglio printing plate. The inking part of the machine is the one disclosed in figure 1, with similar elements referenced in an identical way. Accordingly, there is the duct 1, the duct roller 2, the duct blade 3, the duct roller 2 inking the plate 6 of the selective inking cylinder 5, which preferably carries an engraved plate 6, and the wiping roller 8 wiping the surface of the selective inking cylinder 5. The surface of the wiping roller 8 is scraped by scrape blade 9 and the ink thus scraped is recuperated in the duct 1.

The selective inking cylinder 5 inks then a transfer roller 20 with a deformable surface in order to penetrate the engravings of the plate 6, said transfer roller transferring the ink to a chablon roller 21 with reliefs 22 which then in turn deposit the ink directly in the engravings of a plate of the plate cylinder 23 of the printing machine.

In a direct inking configuration as shown in figure 3, it is necessary to use the transfer roller 20 because of the direction of rotation of the plate cylinder 23.

In figure 4, another configuration of a printing machine is shown. In this configuration, the machine is an indirect inking intaglio printing machine. The inking system represented is similar to the inking system of figure 1 or 3, with similar elements referenced in an identical way. Accordingly, there is the duct 1, the duct roller 2, the duct blade 3, the duct roller 2 inking the surface of the selective inking cylinder 5, which is engraved or carries an engraved plate 6, and the wiping roller 8 wiping the surface of the selective inking cylinder 5. The surface of the wiping roller 8 is scraped by scrape blade 9 and the ink thus scraped is recuperated in the duct 1.

The selective inking cylinder 5 inks then a chablon roller 24 with reliefs 25 which then in turn deposits the ink on a collector cylinder 26. The collector cylinder 26 then deposits the ink in the engravings 27 of a plate cylinder 28 of the printing machine. In this example, the plate cylinder 28 carries three plates.

A wiping unit 45, which is per se common in the art of printing machines, takes off a minimal excess of ink from the engravings and from the plate surface.

A sheet 29 being printed is shown in this figure 4, said sheet passing through the printing nip 30 formed between the plate cylinder and the impression cylinder 31, as is common in the art of intaglio printing. Of course, the system according to the present invention is also suitable for web-fed printing machines.

The principle of indirect inking in an intaglio printing machine is well known per se in the art and is disclosed, for example, in US patents 4,516,496, 5,062,359 and 5,899,145 mentioned above, incorporated by reference in the present application in this respect.

The configuration of printing machine disclosed in figure 5, corresponds to a four color indirect inking intaglio printing machine.

It comprises four separate inking units 30, 31, 32 and 33, each with respective selective inking cylinders 34 to 37, the engravings of which (or of the plates they carry) having corresponding engravings 38 on the plate cylinder 39 according to the principle of the present invention. Each inking unit comprises a duct roller 2, an ink supply and a duct blade 3. Ink is applied to the selective inking cylinders 34, 35, 36 and 37 and wiped by wiping roller 8 in the manner described above. Each selective inking cylinders 34, 35, 36 and 37 receives ink of a different color and has engravings corresponding to the desired pattern on the plate of the plate cylinder 39, and the ink is transferred

onto the chablon rollers 40, 41, 42, and 43 of each inking unit.

In this configuration, the selective inking cylinders 34, 35, 36 and 37 may have only the pattern engraved which correspond to the color the selective inking cylinders in meant to transfer. Advantageously, in another embodiment the selective inking cylinders 34, 35, 36 and 37 can be all engraved with the same pattern corresponding to the entire pattern of the plate cylinder 39. In this case the entire pattern receive a different color on said selective inking cylinders 34, 35, 36 and 37 but the selection of ink on each of said selective inking cylinders 34, 35, 36 and 37 is made by the chablon rollers 40-43 to transfer only the necessary ink on the collector cylinder 44. The advantage of this configuration is that selective inking cylinders are all identical which reduces the cost of manufacturing.

Then, the ink of each chablon roller 40, 41, 42, and 43 is transferred onto the collector cylinder 44 which in turn inks the engravings 38 of the plate cylinder 39. A wiping unit 45, which is per se common in the art of printing machines, takes off a minimal excess of ink from the engravings and from the plate surface.

The printing process per se is then carried out on a sheet 40 which passes in a printing nip 41 formed between the plate cylinder 39 and the impression cylinder 42, as is known in the art of printing.

The inking system of the present invention has numerous advantages, such as its simplicity and the important saving of ink it allows. No important quantities of ink are wasted

anymore since there is a wiping right at the level of the ink duct rather than on the plate cylinder where all the colors of ink are then mixed up by the wiping operation and can not be reused. In the present case, only a minimal excess of ink is effectively transferred onto the plate cylinder so a minimal quantity of ink is wiped away and lost.

Of course, the embodiments described are given by way of non limiting examples and many variations are possible within the scope of the claims.

For example, in the configurations of machines shown in figures 3 to 5, one could use the inking system according to figure 2.

Preferably, the chablon rollers are prepared in a conventional way (chablon plate or continuous cylinder). An advantage of the present invention is that the edges of the area patterns of the chablon rollers receive a minimal amount of ink - a few microns thickness. Therefore, the ink does not build up from the edges to the recessed portion of the chablon plate and washing is much easier for the operator.

Preferably, the engraved selective inking cylinders according to the present invention comprise engravings not just corresponding to those of the printing plate, but having lines characterised by:
- identical pattern to that of the printing plate (except for the necessary specular image, i.e. whether or not the pattern engraved on the selective inking cylinders has to

be a mirrored image of the engraved pattern on the printing plate)
- larger than the engravings on the printing plate, to ensure registration and compensation of the position tolerance of the engraved lines on the printing plate
- depth correlated to the depth of the lines in the printing plate; it is in practice suitable to ensure that the engravings on the selective inking cylinders have a depth which is for instance of the order of 30% greater than the depth of the engravings on the printing plate so as to guarantee that an adequate amount of ink is transferred to the printing plate
- engraved using the same technology as for the printing plate.

In case some areas of the printing plate are provided with fine engraved patterns (having a depth of less than a few tens of microns, in particular less than 10 microns), it may not be necessary to provide the corresponding areas on the selective inking cylinder(s) with any engravings at all, engravings being only provided for inking deeper areas on the printing plate. Indeed, the wiping system may be adapted to leave a slight amount of ink on non-engraved areas of the corresponding selective inking cylinder, which amount of ink can be sufficient to ink fine engravings on the plate cylinder.

Regarding the patterns engraved on each selective inking cylinder, it should accordingly be stressed that these engraved patterns are not strictly speaking identical to the corresponding patterns on the printing plate. The expression "corresponding to" used within the scope of the present description to describe the relationship between

the engravings provided on the selective inking cylinder(s) and on the plate cylinder should therefore be construed as meaning that there is a substantial degree of similarity between the engravings, but that slight differences in terms of width, depth and/or position exist. Further, as mentioned above, parts of the surface of the selective inking cylinder(s) which correspond to fine engravings on the plate cylinder may not be provided with any engravings at all, since non-engraved areas of the selective inking cylinder(s) could carry a sufficient amount of ink to ink such fine engravings.

In the embodiments represented in the figures, different ratio of cylinder diameters are presented. For example in figures 3 to 5, the ratio collector cylinder to chablon roller is 3 to 1, whereas in figure 2, the ratio is 2 to 1. This is of course not to be construed as limiting but as showing that different configurations are possible, equivalent and can be chosen according to the circumstances.

As mentioned above, it is possible for all cylinders having an engraved surface to be directly engraved or to carry an engraved plate through clamping means.